United Nations A/AC.105/1179

General Assembly

Distr.: General
7 May 2018

Original: English

Committee on the Peaceful Uses of Outer Space
Sixty-first session
Vienna, 20–29 June 2018

Coordination of space-related activities within the United Nations system: directions and anticipated results for the period 2018–2019 — a United Nations that delivers

Report of the Secretary-General

I. Introduction

1. In its resolution 72/77, the General Assembly urged the Inter-Agency Meeting on Outer Space Activities (UN-Space), under the leadership of the Office for Outer Space Affairs of the Secretariat, to continue to examine how space science and technology and their applications could contribute to the 2030 Agenda for Sustainable Development, and encouraged entities of the United Nations system to participate, as appropriate, in UN-Space coordination efforts.

2. UN-Space is the focal point for coordination and cooperation in space-related activities. It was set up in the mid-1970s with the aim of promoting synergies and preventing duplication of efforts related to the use of space technology and applications in the work of United Nations entities.

3. At its thirty-seventh session, held in Geneva on 24 August 2017, UN-Space noted that the Committee on the Peaceful Uses of Outer Space, at its fifty-ninth session, in 2016, had welcomed with appreciation the report of the Secretary-General entitled "Coordination of space-related activities within the United Nations system: directions and anticipated results for the period 2016–2017 — meeting the 2030 Agenda for Sustainable Development" (A/AC.105/1115).

4. At the same session, UN-Space agreed that the reports of the Secretary-General on the coordination of space-related activities within the United Nations system served as a strategic tool for the United Nations to avoid duplication of efforts in the field of space science and technology, and that future reports should continue to highlight the efforts of the United Nations system entities in delivering as one in space-related activities to further the development agenda.

5. Also at that session, UN-Space reviewed its reporting structure and agreed that the reports of the Secretary-General on the coordination of space-related activities within the United Nations should continue to be issued on a biennial basis. UN-Space also agreed that the upcoming report of the Secretary-General on the coordination of space-related activities within the United Nations system: directions and anticipated results for the period 2018–2019, to be presented to the Committee on the Peaceful

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Uses of Outer Space at its sixty-first session, in 2018, should focus on reinforcing synergies in efficiency measures in the use of space science, technology and applications within the United Nations system in supporting global development efforts.

6. The focus of the present report stems from the recognition by the Secretary-General, set out in his report entitled "Repositioning the United Nations development system to deliver on the 2030 Agenda: ensuring a better future for all", that there was an urgent need for the United Nations development system to move beyond coherence and coordination towards greater leadership, integration and accountability for results on the ground (see A/72/124–E/2018/3, para. 119).

7. To assist the Committee in its preparations for the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50), to be commemorated in 2018, the present report contains an overview of the efforts made by United Nations entities to contribute to the four main themes known as pillars, namely space economy (the development of space-derived economic benefits), space society (the evolution of society and societal benefits stemming from space-related activities), space accessibility (all communities using and benefiting from space technology) and space diplomacy (building partnerships and strengthening international cooperation in and governance of space activities). For more background on UNISPACE+50, see A/AC.105/1137.

8. The present report, which is the thirty-eighth report of the Secretary-General on the coordination of space-related activities within the United Nations system, was prepared by the Office for Outer Space Affairs on the basis of submissions from the following United Nations entities: the Department of Field Support and the Department of Economic and Social Affairs of the Secretariat, the Economic Commission for Africa (ECA), the Economic and Social Commission for Asia and the Pacific (ESCAP), the Office for Disarmament Affairs of the Secretariat, the Office for Outer Space Affairs, the International Telecommunication Union (ITU), the World Health Organization (WHO) and the World Meteorological Organization (WMO).

9. The present report adds to the description of activities contained in the reports of the Secretary-General on the coordination of space-related activities within the United Nations system for the periods 2010–2011 (A/AC.105/961), 2012–2013 (A/AC.105/1014), 2014–2015 (A/AC.105/1063) and 2016–2017 (A/AC.105/1115) and reflects activities planned for the period 2018–2019. Additional information is available on the website dedicated to the coordination of outer space activities within the United Nations system (www.un-space.org).

II. Reinforcing synergies in efficiency measures in the use of space science, technology and applications within the United Nations system in support of global development efforts

A. Space economy

10. In the 2030 Agenda, Member States have established prosperity as one of their overarching aspirations, committing themselves to ensuring that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature. The same aspiration is reflected in the space economy pillar. Space science, technology and applications create value and benefits contributing to economic growth and serve as major drivers for a dynamic economy.

11. Looking towards UNISPACE+50 in 2018, the Office for Outer Space Affairs launched a series of high-level forums under the umbrella of the United Nations on the theme "Space as a driver for socioeconomic sustainable development", giving the space community an opportunity to address cross-sectoral matters by integrating the economic, environmental, social, policy and regulatory aspects of space activities in pursuit of global sustainable development, as well as to forge new partnerships and

set new frameworks for international cooperation. The first and second high-level forums on space as a driver for socioeconomic sustainable development were held in Dubai, United Arab Emirates, in 2016 and 2017, respectively, as part of the preparations for UNISPACE+50 with the aim of advancing the debate on the role of space science and technology in fostering global development. The third High-level Forum on space as a driver for socioeconomic sustainable development, to be held in Bonn, Germany, from 13 to 16 November 2018, is to continue to demonstrate the broad benefits of space as an area of innovation, inspiration, interconnectedness, integration and investment, and to strengthen unified efforts at all levels and among all relevant stakeholders in the space sector.

12. In its resolution 72/77, the General Assembly welcomed the adoption of the African Space Policy and Strategy by the Assembly of the African Union at its twenty-sixth ordinary session, held in Addis Ababa in January 2016, and noted that that achievement marked the first step towards the realization of an African outer space programme within the framework of the African Union Agenda 2063. More information on how United Nations entities can assist African countries is contained in a note by the Secretariat entitled "Space benefits for Africa: contribution of the United Nations" (A/AC.105/941).

13. ECA actively contributed to the preparation of the African Space Policy and Strategy through a working group of African Union member States guided by sectoral ministerial conferences. The Policy and Strategy contains ambitious goals to mobilize the continent to develop the institutions and capacities necessary to harness space technologies for socioeconomic benefits so as to improve the quality of life and create wealth for Africans.

14. ESCAP is currently developing a plan of action for the Asia-Pacific region on space applications for sustainable development (2018–2030) that is intended to guide the work of the regional space technology applications programme to implement the 2030 Agenda. The plan of action will contain strategies specific to the Asia-Pacific context that cover people, the environment and the economy while drawing from and contributing to global initiatives including the UNISPACE+50 process. The plan of action will also focus on the priorities outlined in the ESCAP publication "Regional roadmap for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific", namely social development, disaster risk reduction and resilience, climate change, the management of natural resources, seamless connectivity for the 2030 Agenda and energy, to be pursued by strengthening regional mechanisms for the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Paris Agreement on climate change, among other things. The plan of action will set out ways of harnessing frontier technologies and their applications, as well as implementation and evaluation plans for several years that cover thematic areas of interest and are linked to global development frameworks and initiatives on the use of space data and space information.

15. The impact of extreme weather events and climate change on economic development, food security, health and migration continues to increase, as highlighted in the WMO publication "Statement on the state of the global climate in 2017". With countries working to fulfil their commitment to the 2030 Agenda, the demand for accessible and accurate weather, climate, hydrological, marine and related environmental services will continue to grow in the years ahead. To meet this demand, WMO, through its Space Programme, conducts a wide range of activities and acts as a bridge between satellite operators and users with the overall objective of promoting the wide availability and utilization of satellite data and products for weather, climate, water and related applications by WMO members. Data acquired by environmental and meteorological satellites have contributed to improving weather and climate predictions. With the deployment of a growing number of operational satellite constellations, this development is expected to continue.

16. Two topics related to space will be considered during the ITU Plenipotentiary Conference to be held in Dubai, United Arab Emirates, from 29 October to

16 November 2018. The first is a decision whether ITU should become the supervisory authority of the international registration system under the Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets. The second topic is the progress made since the Plenipotentiary Conference adopted, in Busan, Republic of Korea, in 2014, its resolution 186 on strengthening the role of ITU with regard to transparency and confidence-building measures in outer space activities. In Geneva, shortly after the Conference, namely from 3 to 7 December 2018, ITU will host its world radiocommunication seminar, a capacity-building event for spectrum regulators and the satellite industry, with in-depth presentations on the provisions of the ITU Radio Regulations applicable to satellite systems and training workshops to get hands-on experience with ITU notification procedures.

17. The end of 2018 and the beginning of 2019 will see the final preparations for the World Radiocommunication Conference 2019, to be held in Sharm-el-Sheikh, Egypt, from 28 October to 22 November 2019. The Conference will revise the Radio Regulations, the international rules governing the use of radio-frequency spectrum and satellite orbits. Multiple items related to satellite systems are on the agenda, such as: finding globally harmonized frequency bands for the telecommand and telemetry of satellites with short missions such as nanosatellites; defining a regulatory framework that will enable the use of Earth stations in motion to provide Internet connectivity on planes, ships, trains or other means of transportation; establishing regulatory provisions to allow non-geostationary mega-constellations to be deployed and operated at a steady pace commensurate with existing launch capabilities; and identifying frequencies for the space component of the Maritime Very High Frequency (VHF) Data Exchange System. The topic of suborbital flights will also be addressed, in particular the question whether radio stations used for such flights should be considered as belonging to the aeronautical or to the space domain.

18. The Office for Outer Space Affairs continues to discharge the obligations of the Secretary-General under the United Nations treaties and principles on outer space. Since the establishment of the Register of Objects Launched into Outer Space in 1961, more than 7,300 functional space objects (satellites, probes, landers, crewed spacecraft and space station flight elements) have been registered with the Secretary-General by more than 55 States and intergovernmental organizations. In 2017, the Office processed registration submissions for 489 functional space objects, the largest number in any single year. A further 64 non-functional space objects (rocket stages, inter-satellite structures and space debris) were registered. With the ever-increasing number of space object launches, the registration system plays an important role in ensuring the responsible conduct of space activities that have the potential of providing economic benefits for sustainable development on Earth.

19. The Office, through workshops and expert meetings organized under the United Nations Programme on Space Applications, brings together experts, decision makers and practitioners to share experience and knowledge among regions, with the aim of defining the actions and follow-up activities required to improve the use of space technology for the management of natural resources and for monitoring the environment. In 2018, the Office will conduct its activities in Argentina (on global navigation satellite systems), Austria (on space partnership for the Sustainable Development Goals), Brazil (on basic space technology), China (on the International Committee on Global Navigation Satellite Systems) and Germany (on innovation and infrastructure for development), and has already held one conference in Pakistan (on space technology for water resources management). In December 2017, the Office for Outer Space Affairs and the United Nations Development Programme joined forces by signing a memorandum of understanding to facilitate cooperation in the use of space science and technology to support and promote global sustainable development initiatives of the United Nations.

20. In order to maximize the benefits of the use and application of global navigation satellite systems (GNSS) to support sustainable development, the Office, consistent with its role as the executive secretariat for the International Committee on GNSS,

will continue to promote cooperation on issues related to GNSS compatibility, interoperability, performance and other space-based positioning, navigation and timing matters. China and India expressed their interest in hosting the meetings of the Committee in 2018 and 2019, respectively. The Office will continue to foster cooperation between the Committee and the regional centres for space science and technology education, affiliated to the United Nations, which also serve as information centres for the Committee, and will focus on capacity-building, in particular in relation to GNSS education.

B. Space society

21. The 2030 Agenda is universal and transformative, and people are at its core. In it, Member States have committed themselves to ensuring that all human beings can fulfil their potential in dignity and equality and in a healthy environment. The space society pillar fully accords with the people-centred nature of the 2030 Agenda and extends beyond UNISPACE+50. The value of space activities is increasingly recognized by United Nations entities. In their daily work they increasingly use space technology and applications and space-derived data and information for improving people's quality of life, including in the areas of public health, human security and welfare, disaster management and humanitarian assistance.

22. Under UNISPACE+50 thematic priority 7 (Capacity-building for the twenty-first century), the Office for Outer Space Affairs has been tasked with placing special emphasis on activities targeting the needs of women in developing countries. To pursue that objective, the Office has joined forces with the United Nations Entity for Gender Equality and the Empowerment of Women (UN-Women) to hold an expert meeting on space for women in New York in October 2017. The purpose of the expert meeting was to share ideas and expertise regarding space and women, enhance existing partnerships and forge new ones, strengthen and deliver targeted capacity-building and technical advisory activities, and promote efforts to encourage the participation of women and girls in science, technology, engineering and mathematics education, with a special focus on developing countries.

23. In the public and global health domains, space science, technology and applications, including Earth observation and remote sensing; telecommunication, positioning and tracking; and space-based research play a crucial role in supporting decision-making, improved care, education and early warning measures. More information on activities undertaken by various United Nations entities in the area of space and global health is contained in the special report by UN-Space on the use of space science and technology within the United Nations system for global health (A/AC.105/1091).

24. Key applications of satellite technology in this field include telemedicine, tele-health, disease surveillance systems and health mapping. Space technology offers appropriate and affordable tools to achieve universal health coverage, in particular in remote and rural areas. Universal health coverage is one of the six leadership priorities of the twelfth general programme of work of WHO, which covers the period 2014–2019.

25. WHO is exploring ways and means for improving and promoting the use of space technologies, space systems and space-derived information and data in the global health domain, subject to the availability of sufficient financial and human resources. In so doing, WHO focuses on the following aims: (a) to strengthen country health systems and the delivery of health services at national and subnational levels; (b) to assist in forecasting and raising the alert of public health epidemics at national and subnational levels; (c) to respond to health emergencies; and (d) to provide technical assistance to Member States in establishing a research agenda on the benefits of space science and technologies to public health. In particular, WHO is focusing its efforts on Earth observation data relevant to climate and climate change as a determinant of health; tele-health and epidemiology; water mapping, quality

assessment, sanitation and hygiene; big data analytics, pattern recognition and visualization; education, training and capacity-building; emergency medical response and routine health care; and healthy living and non-communicable diseases.

26. In the area of space technology applications and public health, WHO has held discussions with numerous national space agencies about using existing technological capabilities in the service of public health and jointly developing new capabilities, in particular in e-health and telemedicine, deployable and miniature laboratory technology, and environmental monitoring. In the area of research, applications and technology relating to human spaceflight, a number of health areas are being explored, including personalized medicine, nutrition, healthy living and exercise, health issues associated with ageing, and water treatment and sanitation. In the area of education and capacity-building, WHO is working with space agencies to promote healthy living and exercise among school children, and on programmes to train teachers on specific subjects such as climate change.

27. To foster a dialogue about improving the utilization of space-based technologies and data in support of global health, and to showcase selected global health initiatives and their various uses of space technologies, data access, data provision services and information-sharing, the United Nations/WHO/Switzerland Conference on Strengthening Space Cooperation for Global Health was held in Geneva in August 2017 (see A/AC.105/1161). To implement the Conference's recommendations, the Office for Outer Space Affairs and WHO are working on a memorandum of understanding to strengthen institutional arrangements for effective collaboration.

28. At its fifty-fifth session, held in January and February 2018, the Scientific and Technical Subcommittee, recognizing the importance of Sustainable Development Goal 3 (Ensure healthy lives and promote well-being for all at all ages) and of UNISPACE+50 thematic priority 5 (Strengthened space cooperation for global health), and taking note of the final report on thematic priority 5 (A/AC.105/1172) and of the progress report by the Co-Chairs of the Expert Group on Space and Global Health of the Scientific and Technical Subcommittee on the fourth meeting of the Expert Group (A/AC.105/C.1/2018/CRP.17), agreed to establish a new item entitled "Space and global health" on its agenda and a working group under that item, with Switzerland as Chair.

29. United Nations entities are working with space agencies to maximize the use of Earth observation data and products relevant to health that are readily available through existing mechanisms and portals, such as the Group on Earth Observations and Copernicus. Focus areas could include water mapping, linking geographical information system and health data, climate change and determinants of health, and disaster response. WMO works closely with WHO on health-related issues such as through the WHO/WMO joint office on health and climate and the global platform on air quality and health. Collaboration is ongoing with other United Nations bodies, agencies and international organizations, including the Statistical Commission, the Group on Earth Observations and the World Bank.

30. As part of efforts to deepen collaboration in the European region, WHO and the European Space Agency are expanding their efforts to achieve, at the national level, the health-related targets of the 2030 Agenda through an integrated approach and, in line with the WHO priority of universal health coverage, the achievement of Sustainable Development Goal 3 and the future WHO thirteenth general programme of work.

31. United Nations entities use space technology in their activities aimed at enhancing food security and sustainable food production. More information on this topic is contained in the special report of UN-Space on the use of space technology within the United Nations system for agriculture development and food security (A/AC.105/1042).

32. Through its Regional Drought Mechanism, ESCAP helps countries to utilize space-derived information available from spacefaring countries in the Asia-Pacific

region and service nodes in China, India and Thailand to ensure comprehensive real-time drought monitoring, manage an early warning system and seamlessly link long-term climate scenarios with seasonal climate outlooks. The Mechanism works to determine the most appropriate products and services obtained with frontier space technology, build capacity and disseminate information to people in need.

33. To further develop its Regional Drought Mechanism, ESCAP has established new partnerships with United Nations agencies and regional institutes with a view to offering a complementary range of information and knowledge products and services to support drought management, contribute to the future implementation of the regional plan of action on space applications for sustainable development for the period 2018–2030 and build capacity to use its information and services. The information and services are to be provided by various countries through regional cooperation. They will be twinned with drought-prone developing countries to support them in building resilience to drought.

34. ESCAP and the Association of Southeast Asian Nations (ASEAN) are preparing a joint study on drought in which they will propose to capitalize on knowledge-based innovations by promoting risk-sensitive policies and interventions based on in-season and long-term drought monitoring and assessment. The study contains strong scientific evidence that the drought risk in ASEAN countries is growing, especially since the 2015/2016 El Niño event, which triggered large-scale drought, floods and landslides and severely affected agriculture. The study will further show that the incidence of the El Niño phenomenon is likely to increase in the future.

35. WMO provides climate services to farmers, herders and fishermen in order to promote sustainable agricultural development, increase agricultural productivity and contribute to food security through its Agricultural Meteorology Programme. Other contributing programmes of WMO are the Hydrology and Water Resources Programme and the Integrated Drought Management Programme, which are informed by satellite-derived products. WMO is also strengthening its collaboration with the Food and Agriculture Organization of the United Nations to deepen cooperation and respond to climate variability and climate change and to strengthen agro-meteorological services.

36. The effectiveness of response and relief operations during and after natural disasters and in complex humanitarian emergencies is highly dependent on space technology. Space technology facilitates data collection and transmission, smooth and expedient communications, and tracking and tracing efforts during such devastating events. The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) promotes the use of space-based information in disaster management, disaster risk reduction and emergency response operations with a view to closing the gap between the information's potential and the actual use currently made of it. UN-SPIDER raises awareness of the benefits of space technologies for disaster management and is aimed at building the capacities of Member States to use those benefits effectively.

37. Combining regional and global approaches, UN-SPIDER will continue to organize technical advisory missions, conferences, workshops, discovery days and thematic expert meetings. Such events enable Member States to exchange knowledge and experiences and learn about innovative methods, best practices and opportunities to access satellite-derived resources. In 2018, technical advisory services and training sessions will be held in Bangladesh, Benin, Cambodia, Cameroon, Ghana, Namibia, Nepal, Nigeria, Sierra Leone, Sri Lanka, Viet Nam and Zimbabwe. International workshops will be held in China, Germany, India and Mongolia to promote and foster the use of Earth observation in the full cycle of disaster management and support implementation of the Sendai Framework for Disaster Risk Reduction.

38. UN-SPIDER serves as the secretariat of the Global Partnership using Space-based Technology Applications for Disaster Risk Reduction (GP-STAR), a multi-stakeholder, voluntary partnership launched at the Third World Conference on Disaster Risk Reduction, held in Sendai in 2015. GP-STAR supports the

implementation of the Sendai Framework by, inter alia, giving advice to governments, organizations and projects on the use of space technologies and applications in disaster risk reduction efforts, and through the provision of relevant publications. In its function as secretariat, the UN-SPIDER programme organized and conducted monthly videoconferences to ensure the implementation of the workplan, published a brochure giving an overview of GP-STAR, and prepared and conducted a side event during the 2017 Global Platform for Disaster Risk Reduction, held in Cancún, Mexico.

39. The Office for Outer Space Affairs will continue to support the International Working Group on Satellite-based Emergency Mapping. The Working Group was formed in the aftermath of the largely uncoordinated emergency mapping efforts during the Haiti earthquake of 2010, to improve coordination and work-sharing among the entities involved.

40. The WMO Disaster Risk Reduction Programme is aligned with the Sendai Framework. Its activities are integrated and coordinated with other international, regional and national organizations. To support disaster risk reduction efforts, WMO is preparing to operate a global multi-hazard early warning system. The system will provide WMO members, United Nations agencies, humanitarian organizations, Governments and other relevant stakeholders with aggregated and standardized authoritative multi-hazard alerts and warnings based on the Common Alerting Protocol. The alerts and warnings will be issued by members' national meteorological and hydrological services and other officially registered alerting authorities. The Climate Risk and Early Warning Systems initiative is aimed at mobilizing the funds required to strengthen risk information and early warning systems in vulnerable countries. The WMO Space Programme is supporting those efforts.

41. The ESCAP publication *Leave No One Behind: Disaster Resilience for Sustainable Development — Asia-Pacific Disaster Report 2017* shows that those countries in the region that have the least capacity to prepare for or respond to disasters suffer the greatest impact. It also shows that future natural disasters may be more destructive. ESCAP research indicates that, beyond the human cost, 40 per cent of global economic losses from disasters between 2015 and 2030 will occur in the Asia and the Pacific, a region that accounts for around 36 per cent of global gross domestic product. ESCAP suggests that measures for disaster risk reduction should take account of the shifting risks associated with climate change, especially in risk hotspots where a greater likelihood of change coincides with a higher concentration of poor, vulnerable or marginalized people.

42. ESCAP, in close collaboration with partners in the United Nations system and with ASEAN, has developed a series of handbooks offering guidance in harnessing innovative space applications to cope with disaster risk in the region. The titles in the series include *Sharing Space-based Information: Procedural Guidelines for Disaster Emergency Response in ASEAN Countries* (developed in collaboration with UN-SPIDER and the Operational Satellite applications Programme of the United Nations Institute for Training and Research), *Specific Hazards: Handbook on Geospatial Decision Support in ASEAN Countries* and *Innovations in Disaster Rapid Assessment: A Framework for Early Recovery in ASEAN Countries*. The series promotes the development of institutional capacity for countries that wish to include innovative space-based information in their disaster risk management processes, and to address the needs of geospatial information providers and decision makers.

43. ESCAP has been working with Pacific countries and regional institutes to strengthen multi-hazard early warning systems in the Pacific region. Work has focused on the development of knowledge and the capacity to use space technology and geographical information systems applications as crucial elements in efforts to attain universal access to disaster early warning information. ESCAP and its regional partners have conducted a series of intensive training courses to build capacity. They have also completed pilot projects in Fiji, the Federated States of Micronesia, Papua New Guinea, Solomon Islands and Tonga which included technical service, tailored toolboxes and model development for weather research forecasting, ocean wave

monitoring and drought early warning. The project also contributed to South-South cooperation through the sharing of expertise available in institutes in Thailand and Indonesia.

44. WMO is the co-custodian for Sustainable Development Goal 13 (Take urgent action to combat climate change and its impacts) and leads the work on the Global Climate Observing System (GCOS). GCOS is an integrated, long-term endeavour to systematically observe the Earth's changing climate and to identify the measurements required to support adaptation measures and the way in which they could support observations at the local and regional levels. Many observation products do not yet exist and specific action is required to develop guidance for the provision of high-resolution global or regional data sets obtained from satellite products or by downscaling model results. More specifically, there is a GCOS implementation plan that is based on a set of essential climate variables that have been identified. In the near future, measurements of anthropogenic greenhouse gas fluxes made on board space-borne platforms will be available to augment the bottom-up approaches recommended in the guidelines of the Intergovernmental Panel on Climate Change and to improve integrated estimates of emissions in line with the Paris Agreement on climate change for a global stocktaking exercise once every five years. The first global round of stocktaking, to be held in 2023, will benefit from prototype systems. Those prototypes are expected to be developed into a more operational system at a later date.

45. GCOS activities are closely coordinated with those space agencies that are developing and operating relevant space-borne platforms, including the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS). In 2010, CEOS and CGMS together established the Working Group on Climate, which coordinates and encourages collaborative activities between the world's major space agencies in the area of climate monitoring. The overarching goal is to improve the systematic availability of climate data records through the coordinated implementation and further development of a global architecture for climate monitoring from space.

46. More information is contained in the special report of UN-Space on the use of space technology within the United Nations system to address climate change issues (A/AC.105/991).

C. Space accessibility

47. The 2030 Agenda will be implemented by all countries and stakeholders, acting in collaborative partnership and with the determination to take the bold and transformative steps that are urgently needed to shift the world onto a path towards sustainability and resilience. Space-derived information is a key decision-making tool for the efficient management of assets, environments and communities. Nonetheless, bottlenecks and gaps exist with respect to access to space-derived information and its interpretation, analysis and usage, because, at present, it is provided mainly by the private sector, Governments and specialized agencies. Efforts are being made within the United Nations system to increase and streamline the use of data and information derived from space-based platforms.

48. Promoting and facilitating the visibility, free accessibility and ease of utilization of space science data, in particular astronomical data, collected by space- and ground-based facilities is the objective of the Open Universe initiative of the Office for Outer Space Affairs, conducted in partnership with Italy. The initiative, recommended for establishment at the United Nations/Italy Workshop on the Open Universe Initiative held in Vienna in November 2017, is aimed at enhancing and completing the online availability and visibility of astronomical and space science data following internationally agreed standards; and promoting the development of software applications and educational and outreach environments for astronomy and space science to further the progress of society in terms of culture and knowledge, in

particular among young people and women, irrespective of the level of development of a country.

49. The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) is the top intergovernmental global geospatial policymaking body. It fosters a geospatial approach to attaining the Sustainable Development Goals and has been successful in building a global architecture as well as regional geospatial committee architectures in Asia and the Pacific, the Americas, the Arab States, Europe and Africa. UN-GGIM has entered the second five-year phase of its work programme, in which its focus is on strengthening the national capabilities, capacities and institutional arrangements of geospatial information in Member States. The various work programmes put a strong emphasis on integrating national information systems for measuring and monitoring the progress towards Sustainable Development Goals, capacity-building and national-level implementation. The Department of Economic and Social Affairs and the Department of Field Support continue to provide UN-GGIM with Secretariat support.

50. UN-GGIM has asked the Secretariat for an overview of existing geospatial information resources, activities and governance arrangements within the United Nations system. During the seventh session of UN-GGIM, held in August 2017, the Secretariat reported that, as many coordination activities were being carried out on a "best efforts" basis by geospatial practitioners within and across the United Nations system and that the current informal collaborative mechanisms required attention from senior management of the United Nations and UN-GGIM so as to improve the coordination and coherence. As a direct outcome of its seventh session, UN-GGIM agreed to establish a United Nations system network under the umbrella of UN-GGIM. While the terms of reference, modalities and mechanisms of the new network are yet to be determined, the Secretariat is contacting actors interested in preparing its establishment within the United Nations system, to be endorsed by UN-GGIM at its eighth session, in August 2018.

51. At its fifth session, in August 2015, UN-GGIM created the working group on geospatial information and services for disasters to develop a strategic framework in which all stakeholders and partners involved in disaster risk reduction and/or emergency management could ensure that geospatial information and services are of high quality and can be accessed in a coordinated way to support decision-making and operations before, during and after disasters. At its seventh session, in August 2017, UN-GGIM adopted a strategic framework on geospatial information and services for disasters and endorsed the consideration of drafting a resolution to be presented for adoption by the Economic and Social Council. The draft resolution is currently being prepared by Member States for consideration by the Council in July 2018.

52. The United Nations Geographic Information Working Group held no plenary meeting in 2017. The Office for Outer Space Affairs voluntarily continued to act as Chair of the Working Group until another entity would volunteer to do so. At the same time, the Office hosted and managed, with support from the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization, the web server and mailing lists of the Working Group, thereby ensuring that communication and information-sharing within the United Nations system continued on all aspects of geospatial information management and data-sharing. It is still envisaged to convene a plenary meeting in late 2018 or early 2019 to address developments and cooperation requirements, to ensure the Working Group's continuity and to review future plans to adjust efforts to the current and future priorities of the United Nations system, including the Sustainable Development Goals. The Working Group and its members could possibly be re-engaged in the context of the newly proposed United Nations system network in the context of UN-GGIM.

53. The Regional Committee of United Nations Global Geospatial Information Management for Africa was established under the leadership of ECA. Through the work of the Regional Committee, Member States have agreed on a basic set of

concepts, practices, standards and guidelines for the development and management of geospatial information in Africa. The African Regional Spatial Data Infrastructure supports regional initiatives, such as the production of a seamless mosaic of digital elevation model data and the launch of a study to develop guidelines of best practices for geospatial data sets. In collaboration with the Department of Economic and Social Affairs and the Department of Field Support, ECA continues to follow up the validation process of the Second Administrative Level Boundaries data set project in Africa.

54. Through the international steering committee of the African Geodetic Reference Frame project, ECA has continued to develop a unified geodetic reference frame to contribute to the harmonization of geographic data and statistics in Africa. In 2018, 2019 and beyond, ECA will continue to champion the development and implementation of spatial data infrastructures in African countries, focusing on articulating policies, strategies and guidelines to develop and enhance the effective use of geospatial products and resources. Expert advice and technical support will be provided to member States and subregional and regional institutions to strengthen their geospatial information policies and resources.

55. Since 2016, ESCAP has provided around 320 satellite imagery and tailored tools and products to its member States for early warning, response and damage assessment relating to earthquakes, floods, drought, typhoons, cyclones and landslides. All of these space-based data, products and services were provided free of charge by ESCAP member States through the Regional Space Applications Programme for Sustainable Development network and the partnership with other United Nations agencies and international/regional initiatives. Their value was equivalent to approximately $1.4 million.

56. The Geospatial Information Section of the Department of Field Support continued to coordinate the provision of selected products and services to the Secretariat to support the management of operations, situational awareness and geospatial intelligence for crisis response operations. The volume of analytical products and services based on satellite imagery that has been provided to the Security Council and its subsidiary organs and to the United Nations Operations and Crisis Centre have increased at a rapid pace. This trend reflects the growing interest of senior management of the United Nations system to leverage evidence-based data and information in its decision-making process.

57. In early 2016, new contracts were concluded with vendors for the provision of a wide range of medium- and high-resolution, optical and radar satellite imagery. Those contracts include services and products with added value that are based on data derived from satellite imagery, such as change detection or geospatial intelligence used for crisis response operations. Another contract was concluded for the provision of advanced geospatial services that include feature extraction, to produce large-scale topographic data and maps, and image analysis.

58. The Office for Outer Space Affairs is availing itself of the memorandum of understanding with the China National Space Administration for the provision of imagery for disaster management, monitoring the effects of climate change and supporting efforts to attain the Sustainable Development Goals. The satellite images were offered during emergencies and plans are being made to offer images for use in specific projects in developing countries.

59. The Office is also availing itself of the memorandum of understanding with DigitalGlobe to increase awareness of new, very high-resolution space-based data and services within the United Nations, and to promote the availability of and access to such data and the provision of open data to the United Nations system during disasters. In the spirit of the memorandum of understanding, DigitalGlobe will continue to provide archived and contemporary imagery freely accessible to the international community to support emergency response operations. Also in the spirit of the memorandum, DigitalGlobe, through its Open Data programme, will continue to

provide archived and newly collected, after-the-event imagery freely accessible to the international community to support responses to major disasters globally.

60. Under the WMO Space Programme, several databases are maintained that contribute to space accessibility. They include the Observing Systems Capability Analysis and Review Tool, a database of Earth observation payloads and missions and observation requirements to support Earth observation applications, gap-analysis studies and global coordination, the Satellite User Readiness Navigator portal, which is intended to help Members prepare for the next generation of meteorological satellites, databases on data products[1] and processing tools.[2]

61. CGMS ensures the global end-to-end coordination of meteorological satellite systems between satellite operators and user communities such as WMO and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization. CGMS encourages complementarity, compatibility and mutual backup in the event of system failure, and does so through cooperative mission planning, compatible meteorological data products and services, and the coordination of space- and data-related activities, thus complementing the work of other international satellite coordinating mechanisms.

62. The WMO/CGMS Virtual Laboratory for Training and Education in Satellite Meteorology is a global network of specialized training centres and meteorological satellite operators working together to improve the utilization of data and products from meteorological and environmental satellites. It was established by WMO, through its Space Programme, and CGMS to support capacity-building.

63. The Office for Outer Space Affairs continues to participate actively in the working groups of CEOS, acting, by virtue of its mandate, as a liaison between the United Nations and the CEOS community. The Office will continue to contribute to and support capacity-building activities related to the provision of and access to space-based data within the CEOS Working Group on Disasters and the CEOS Working Group on Capacity-building and Data Democracy by organizing joint training workshops for developing countries. In 2017, the Office supported a training course held in Gabon that was coordinated by the Working Group on Capacity-building and Data Democracy. Its topic was the use of synthetic aperture radar satellite imagery.

64. The UN-SPIDER knowledge portal contains databases made up of freely available satellite data, derived products and software, and compilations of all relevant maps and resources for selected major disasters. The Office for Outer Space Affairs is strengthening the UN-SPIDER network of regional support offices, which currently has 21 members, to ensure that recommended practices and other references, tools and services are shared more widely.

D. Space diplomacy

65. The scale and ambition of the 2030 Agenda, underpinned by the United Nations values of peace, dialogue and international cooperation, require revitalized international partnership to ensure its implementation. Through the 2030 Agenda, world leaders have envisaged a world in which good governance and an enabling environment at the national and international levels are essential for sustainable development, including sustained and inclusive economic growth, social development, environmental protection and the eradication of poverty and hunger, all of which would benefit from stronger space governance and supporting structures at all levels, including improved space-based data and space infrastructure.

66. The Office for Outer Space Affairs continues to support the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies in promoting international

[1] See https://www.wmo-sat.info/product-access-guide/.

[2] See http://www.wmo.int/pages/prog/sat/processingtools_en.php.

cooperation in space activities for peaceful purposes, including in preparation for UNISPACE+50, which offers a unique opportunity for Member States to reflect on more than 50 years of achievement in space exploration and to look towards the future. The UNISPACE+50 high-level segment process, to be held on 20 and 21 June 2018 and open to all States Members of the United Nations, is expected to culminate in a resolution to be considered at the seventy-third session of the General Assembly. In accordance with its resolution 72/79, the Assembly will consider in plenary meeting at its seventy-third session an agenda item entitled "Space as a driver of sustainable development" in the context of UNISPACE+50.

67. The General Assembly, in accordance with its resolution 71/90, convened a joint half-day panel discussion of its Disarmament and International Security Committee (First Committee) and Special Political and Decolonization Committee (Fourth Committee) to consider possible challenges to space security and sustainability. The panel was organized jointly by the Office for Outer Space Affairs and the Office for Disarmament Affairs and held in New York on 12 October 2017. The programme, a summary of the debate and the presentations are available on the website of the Office for Outer Space Affairs.

68. Pursuant to requests by the General Assembly, the Office for Disarmament Affairs undertook various efforts to support States in the implementation of the recommendations of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities (see A/68/189). The Office for Disarmament Affairs also continued to support the discussion on the implementation of transparency and confidence-building measures in various disarmament forums, including the Conference on Disarmament, the United Nations Disarmament Commission and the First Committee.

69. In accordance with General Assembly resolution 71/82, the Disarmament Commission held an informal discussion on the practical implementation of transparency and confidence-building measures in outer space activities with the goal of preventing an arms race in outer space at its 2017 session. On 21 February 2018, the Disarmament Commission decided that the second of two substantive items for its 2018–2020 cycle would bear the title "In accordance with the recommendations contained in the report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities (A/68/189), preparation of recommendations to promote the practical implementation of transparency and confidence-building measures in outer space activities with the goal of preventing an arms race in outer space".

70. In its resolution 72/250 on further practical measures for the prevention of an arms race in outer space, the General Assembly requested the Secretary-General to establish a new group of governmental experts to consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including on the prevention of the placement of weapons in outer space. The group will meet in 2018 and 2019.

71. In February 2018, the Conference on Disarmament decided to establish five subsidiary bodies, including one on its agenda item on preventing an arms race in outer space. The subsidiary bodies have been tasked with seeking to reach an understanding on common areas, deepening technical discussions, and considering effective measures, including legal instruments, for negotiations.

72. More information on relevant activities undertaken by various United Nations entities is contained in the special report by UN-Space on the role of United Nations entities in supporting Member States in the implementation of transparency and confidence-building measures in outer space activities (A/AC.105/1116).

73. Building on the success of the series of ten United Nations workshops on space law, the Office for Outer Space Affairs will hold the first United Nations Conference on Space Law and Policy in Moscow from 11 to 13 September 2018. The Conference

is being organized jointly with the Government of the Russian Federation and the State Space Corporation "Roscosmos". Participants will be given an overview of the legal regime governing the peaceful uses of outer space and will examine the broader perspective of space security, including transparency and confidence-building measures in outer space activities. Discussions will be held on ways and means of maintaining outer space for peaceful purposes, challenges to the long-term sustainability of outer space activities, legal aspects of space debris mitigation and remediation, space traffic management and the exploration, exploitation and utilization of space resources. The Conference will also study trends in and challenges to the progressive development of space law and assess further needs for capacity-building, assistance and outreach in space law and policy.

74. Given the growing number of benefits derived from space science and technology applications, space activities by all the main players continue to expand rapidly. This not only increases interaction between the aviation and space communities, both commercial and private, but also makes the need more pressing to explore existing regulatory mechanisms and operational practices in the fields of aviation and space transportation. To address that need, the International Civil Aviation Organization (ICAO) and the Office for Outer Space Affairs hosted a series of aerospace symposiums held in Montreal, Canada, in March 2015, in Abu Dhabi in March 2016 and in Vienna in August 2017 (see A/AC.105/1155).

75. Participants in the series of symposiums have made efforts to strengthen the dialogue between the aviation and space communities. Participants expressed the view that the unique, coordinated inter-agency effort should be reflected in the second phase of cooperation and in the work of ICAO and the Office for Outer Space Affairs. In view of the rapid development of commercial space transportation and the inherently different international regimes for aviation, space flight and space activities, participants observed a need for better intergovernmental coordination with the involvement of the Office for Outer Space Affairs, ICAO, ITU and the International Maritime Organization in areas of concern with respect to the launching of space vehicles from maritime areas.

76. The seventeenth World Meteorological Congress, held in May 2015, tasked WMO with ensuring the international coordination of operational monitoring and forecasting of space weather with a view to supporting the protection of life, property and critical infrastructure and the economic activities affected by space weather. In June 2016, the WMO Executive Council approved a four-year plan for WMO activities related to space weather for the period 2016–2019. The four-year plan is aimed at enabling States members of WMO to establish fully operational space weather services, share observation data, products and best practices and ensure interoperability and standardization, as appropriate, to efficiently respond to global challenges related to space weather.

77. The Executive Council further agreed to replace the WMO expert team on space weather, named Inter-Programme Coordination Team on Space Weather, which had been established in May 2010 with the newly established Inter-Programme Team on Space Weather Information, Systems and Services and to task the new Inter-Programme Team with coordinating the space weather activities conducted under various WMO programmes and by partner organizations, and to provide guidance to WMO members. The Inter-Programme Team commenced its work in early 2017 and at present includes experts from 23 member States and six international organizations.

78. The eighteenth World Meteorological Congress, to be held in June 2019, is expected to adopt a strategic plan for the period 2020–2023. The new strategic plan will allow WMO to remain fit for purpose and to become even more nimble and cost-effective.

79. The World Radiocommunication Conference 2019 will prepare the agenda of the next Conference, planned for 2023. One item that may be included concerns the

radio spectrum needs of space weather sensors and the means to protect them from interference.

80. The Committee on the Peaceful Uses of Outer Space first started considering issues related to space weather decades ago as part of its general discussions. It continues to do so under dedicated items on the agenda of the Scientific and Technical Subcommittee, such as the single issue/item for discussion on solar terrestrial physics (in 2004), the item on support to proclaim the year 2007 International Geophysical and Heliophysical Year (in 2005), the items under the multi-year workplans relating to the International Heliophysical Year 2007 (since 2006) and the International Space Weather Initiative (since 2010), and under a regular item on space weather (since 2010).

81. Expert group C on space weather was established under the Working Group on the Long-term Sustainability of Outer Space Activities of the Scientific and Technical Subcommittee, under the Subcommittee's agenda item on long-term sustainability of outer space activities. Expert group C was co-chaired by Canada and Japan. In 2014, it produced a working report (A/AC.105/C.1/2014/CRP.15) that served as input to the agreed guidelines for the long-term sustainability of outer space activities, in particular guideline 16 (Share operational space weather data and forecasts) and guideline 17 (Develop space weather models and tools and collect established practices on the mitigation of space weather effects).

82. In 2014, under its agenda item on space weather, the Scientific and Technical Subcommittee established the Expert Group on Space Weather. That Expert Group was mandated to promote awareness, provide guidance and enable communication and cooperation in space weather-related activities among States members of the Committee on the Peaceful Uses of Outer Space and related national and international organizations. At its fifty-fifth session, in 2018, the Subcommittee recommended that the Expert Group continue its work, in accordance with the recommendations contained in the Expert Group's progress report (A/AC.105/C.1/2018/CRP.14).

83. At its fifty-ninth session, in 2016, the Committee on the Peaceful Uses of Outer Space endorsed seven UNISPACE+50 thematic priorities. The objectives under thematic priority 4 (International framework for space weather services) were to strengthen the reliability of space systems and their ability to respond to the impact of adverse space weather; to develop a space weather road map for international coordination and information exchange on space weather events and their mitigation, through risk analysis and assessment of user needs; to recognize space weather as a global challenge and the need to address the vulnerability of society as a whole; increase awareness through developed communication, capacity-building and outreach; and to identify governance and cooperation mechanisms to support this objective. For further information, see the report on thematic priority 4 (A/AC.105/1171).

84. As a flagship event under the thematic priority, the Office for Outer Space Affairs held the United Nations/United States of America Workshop on the International Space Weather Initiative in Boston, United States, from 31 July to 4 August 2017 (see A/AC.105/1160). The event was dedicated to the progress achieved in the ten years since the International Heliophysical Year 2007 and gave participants an opportunity to discuss strategies and future activities.

85. More information on activities undertaken by various United Nations entities in this context is contained in the special report by UN-Space on space weather (A/AC.105/1146).

United Nations A/AC.105/1180

General Assembly

2 March 2018

Original: English

Committee on the Peaceful Uses of Outer Space

Report on the United Nations/South Africa Symposium on Basic Space Technology: Small Satellite Missions for Scientific and Technological Advancement

(Stellenbosch, South Africa, 11–15 December 2017)

I. Introduction

1. The United Nations/South Africa Symposium on Basic Space Technology: Small Satellite Missions for Scientific and Technological Advancement was the fourth in a series of international symposiums on basic space technology development to be held in each of the regions served by the Economic Commission for Africa, the Economic and Social Commission for Asia and the Pacific, the Economic Commission for Latin America and the Caribbean, and the Economic and Social Commission for Western Asia. The symposiums are part of the Basic Space Technology Initiative, which is carried out as part of the United Nations Programme on Space Applications. The Initiative is aimed at supporting capacity-building in basic space technology and promoting the use of space technology and its applications for peaceful purposes and in support of sustainable development.

2. The Symposium was organized by the Office for Outer Space Affairs of the Secretariat and, on behalf of the Government of South Africa, the Department of Science and Technology and the Department of Trade and Industry and the South African National Space Agency. The Symposium was hosted by Stellenbosch University.

3. The present report describes the background, objectives and programme of the Symposium, summarizes the presentations made during its technical sessions and panel discussions, and sets out the recommendations and observations made by the participants. The report has been prepared pursuant to General Assembly resolution 72/77. It should be read in conjunction with the reports on the three United Nations/Austria/European Space Agency symposiums on small-satellite programmes held between 2009 and 2011 (A/AC.105/966, A/AC.105/983 and A/AC.105/1005), the report on the United Nations/Japan Nanosatellite Symposium (A/AC.105/1032), the report on the United Nations/United Arab Emirates Symposium on Basic Space Technology (A/AC.105/1052) and the report on the United Nations/Mexico Symposium on Basic Space Technology (A/AC.105/1086).

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A. Background and objectives

4. The United Nations Programme on Space Applications was launched as a result of discussions at the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), held in Vienna in 1968. The Programme is implemented by the Office for Outer Space Affairs and provides support to all States Members of the United Nations that wish to build capacity in space technology, regardless of their level of economic development. The initial focus of the Programme was on the applications of space technology in, for example, satellite communications, Earth observation and positioning and navigation services.

5. Advances in technology and the acceptance of a higher but still reasonable level of mission risk have resulted in increasingly capable small satellites that can be developed by academic institutions, research centres and similar organizations that have limited infrastructure and budgets for space activities. Many benefits can be derived from the development of small satellites, which has increased interest in establishing basic capacities in space technology development, including in developing countries and in countries that had, to date, been using space applications developed by others.

6. In response to that interest, the Basic Space Technology Initiative was added to the United Nations Programme on Space Applications in 2009. Pursuant to General Assembly resolution 37/90, the Programme should stimulate the growth of indigenous nuclei and an autonomous technological base, to the extent possible, in space technology in developing countries, with the cooperation of other United Nations entities and/or Member States.

7. The Initiative focuses on the development of affordable small satellites with a mass less than 150 kg and on the associated technical, managerial, regulatory and legal issues. It supports capacity-building in basic space technology and its applications for the peaceful uses of outer space in support of sustainable development and, in particular, addresses the contribution of basic space technology to the UNISPACE+50 process and implementing the "Space2030" agenda.

8. The Basic Space Technology Initiative began with the organization of three United Nations/Austria/European Space Agency symposiums on small-satellite programmes held in 2009, 2010 and 2011, followed by the current series of international symposiums, which started in 2012. The theme of the United Nations/Japan Nanosatellite Symposium, held in 2012, was "Paradigm shift: changing architecture, technologies and players". The theme of the United Nations/United Arab Emirates Symposium on Basic Space Technology, held in 2013, was "Small-satellite missions for developing space nations". Finally, the theme of the United Nations/Mexico Symposium on Basic Space Technology, held in 2014, was "Making space technology accessible and affordable".

9. The United Nations/South Africa Symposium had the following main objectives:

(a) Review the status of capacity-building in basic space technology for small satellites, including lessons learned from the past and ongoing development activities with a focus on regional and international collaboration opportunities, in particular for countries in Africa;

(b) Examine issues relevant to the implementation of small-satellite programmes, such as organizational capacity-building, development and testing infrastructure and launch opportunities;

(c) Review state-of-the-art scientific applications of small-satellite programmes and their associated supporting technological developments, with a particular focus on applications for the monitoring of agriculture, the environment and cities, and education to promote a sustainable growth, in line with the 2030 Agenda for Sustainable Development;

(d) Discuss regulatory issues relating to space technology development programmes, such as frequency allocation and space debris mitigation measures for enhancing the long-term sustainability of outer space activities and import and export controls;

(e) Discuss legal issues and responsibilities related to space technology development programmes, such as those arising from international space law;

(f) Discuss the way forward for the Basic Space Technology Initiative and its capacity-building and international cooperation activities in preparation for UNISPACE+50.

10. The Committee on the Peaceful Uses of Outer Space endorsed at its fifty-ninth session seven thematic priorities for UNISPACE+50 (see A/71/20, para. 296). The discussions at the Symposium will inform the preparations for UNISPACE+50, which will be held in 2018 to mark the fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space in 1968. The observations and recommendations of the Symposium will contribute to the UNISPACE+50 process and will be brought to the attention of relevant policy and decision-making bodies.

11. The objectives of the Symposium reflected the aim of the Basic Space Technology Initiative and of the series of associated events related to thematic priority 7 ("Capacity-building for the twenty-first century"). The Symposium also covered activities supporting other thematic priorities, such as:

(a) Thematic priority 1 ("Global partnership in space exploration and innovation"), by promoting international collaboration and cooperation activities;

(b) Thematic priorities 2 ("Legal regime of outer space and global space governance: current and future perspectives") and 3 ("Enhanced information exchange on space objects and events"), by supporting small-satellite missions and raising awareness of the regulatory issues involved having to do with frequency allocation, the registry of space objects, space debris mitigation measures, import and export controls and other legal responsibilities;

(c) Thematic priority 6 ("International cooperation towards low-emission and resilient societies"), by reviewing the role of small satellites in sustainable and resilient cities and societies, and assessing their potential for Earth observation.

B. Attendance

12. The Symposium was attended by 126 space professionals involved in nanosatellite and small-satellite missions from governmental and intergovernmental institutions, universities and other academic entities, and by representatives of the private sector from 33 countries, namely Brazil, China, Costa Rica, Egypt, Ethiopia, France, Germany, Ghana, India, Indonesia, Japan, Kenya, Malawi, Mauritius, Morocco, Namibia, the Netherlands, New Zealand, Nigeria, Pakistan, Peru, the Russian Federation, Singapore, Slovakia, South Africa, Spain, the Sudan, Tunisia, Turkey, Uganda, the United Arab Emirates, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

13. The Symposium was co-sponsored, on behalf of the Government of South Africa, by the Department of Science and Technology, the Department of Trade and Industry, the South African National Space Agency and Stellenbosch University, as well as by the European Space Agency. Funds allocated by the United Nations and the co-sponsors were used to sponsor 31 funded participants. The sponsors also provided funds for the cost of organizing the Symposium and providing facilities, and for the local transportation of all participants.

C. Hands-on workshop before the start of the Symposium

14. As a pilot project, a two-day hands-on workshop was held with Nihon University and the University Space Engineering Consortium-Global (UNISEC-Global) on assembling picosatellites. The objectives were to enhance participants' understanding of basic satellite system architecture, let them experience the process of developing a picosatellite, have them gain experience with space systems engineering by having them assemble, integrate and test a HEPTA-Sat picosatellite kit and train them so that they could lead similar workshops in the future.

15. The workshop was attended by 18 space researchers and students involved in nanosatellite and small-satellite missions. The attendants represented governmental institutions as well as universities and other academic institutions from 11 countries, namely Brazil, Egypt, Ghana, Kenya, Mauritius, Namibia, the Netherlands, Nigeria, South Africa, the Sudan and Uganda. Together, they assembled six picosatellites.

16. The workshop was hosted and sponsored by Stellenbosch University. Nine international participants and two experts were sponsored by the United Nations.

II. Programme

17. The programme of the Symposium was developed by the Office for Outer Space Affairs, the Government of South Africa and Stellenbosch University, in cooperation with the programme committee of the Symposium. The programme committee included representatives of national space agencies, international organizations and academic institutions. An honorary committee and a local organizing committee also contributed to the successful organization of the Symposium.

18. The programme consisted of an opening session, keynote addresses, seven technical sessions, a panel discussion, a poster session and discussions on observations and recommendations, followed by closing remarks by the co-organizers.

A. Opening session

19. At the opening session, welcoming remarks were made by a representative of Stellenbosch University, the Chief Executive Officer of the South African National Space Agency, a representative of the mayor of Stellenbosch, the Deputy Director General of the Department of Science and Technology and a representative of the Office for Outer Space Affairs.

20. In the first keynote address, a representative of the Department of Science and Technology provided an overview of space science and technology in South Africa. He reviewed the history of his country's space activities, which included the establishment of the South African National Space Agency in December 2010, and presented the Agency's current policy and strategy.

21. The second keynote address was delivered by a representative of California Polytechnic State University, who explained the role of small satellites in workforce development and highlighted their contribution to the private sector and their role as a training tool for students.

22. Two introductory presentations were given by representatives of the Office for Outer Space Affairs, who focused on UNISPACE+50, the Basic Space Technology Initiative and the objectives of the Symposium. They were followed by a representative of Stellenbosch University, who gave an overview of the University's satellite projects over the past 25 years.

B. Technical sessions

23. Technical sessions were held on the following topics: (a) space technology development and capacity-building with a focus on Africa; (b) small-satellite missions in support of key scientific projects and questions; (c) applications of small-satellite missions; (d) small-satellite projects for engineering education; (e) regulatory and legal issues and long-term sustainability of outer space activities; (f) other aspects of small satellites; and (g) international experiences and opportunities, followed by a poster session.

1. Space technology development and capacity-building with a focus on Africa

24. A representative of the National Space Research and Development Agency of Nigeria (NASRDA) gave a historical overview of the country's space programme. NASRDA had been focusing on three satellite projects: NigeriaSat-1, launched in 2003; and NigeriaSat-X and NigeriaSat-2, both launched in 2011. It had also developed a geostationary satellite that had been built in partnership with China. The space programme of Nigeria had a strong focus on capacity-building and the transfer of know-how. NASRDA understood that its vision could be realized only through an intense programme of capacity-building, research and international cooperation.

25. The second presentation was given by the African Regional Centre for Space Science and Technology Education — in French Language (CRASTE-LF), affiliated to the United Nations. The objectives of the Centre were to develop educational material; to increase knowledge in space sciences and technologies by offering, at the regional level, postgraduate programmes and shorter courses such as seminars, workshops and conferences to improve the technical competence of experts, teachers and decision-makers; to assist the countries of the region in the development of their own capacity in space tools; to strengthen local and regional capacities; to promote cooperation between developed countries and States served by CRASTE-LF; and to develop expertise in space science and technology.

26. A representative of the Kenya Space Agency argued that CubeSats were a pathway to space for developing countries. This was illustrated by the first Kenya University nanosatellite-precursor flight (1KUNS-PF), to be launched in 2018, which consisted of a 1U CubeSat being developed by students from Kenya and Italy. The CubeSat was part of an international master's degree programme resulting from collaboration between the University of Nairobi and the University of Rome with the support of the Kenya Space Agency and sponsored by the Italian Space Agency. The 1KUNS-PF CubeSat was selected to be the first beneficiary of the KiboCube programme resulting from collaboration between the Office for Outer Space Affairs and the Japan Aerospace Exploration Agency (JAXA).

27. A representative of the South African National Space Agency gave a presentation on the development of space technology in South Africa and the numerous opportunities offered by the Agency for academia and private companies in the country to embark on space activities, and discussed the use of satellite information for socioeconomic development.

2. Small-satellite missions in support of key scientific projects and questions

28. The chief executive officer of New Space Systems introduced stellar gyroscope, a new type of sensor that offered a virtually driftless gyroscope function by using the image processing technology from a simple low-cost camera, making it possible to create low-cost communications constellations. The stellar gyroscope had been developed with support from the Aerospace Industry Support Initiative, which was managed jointly by the Department of Trade and Industry of the Government of South Africa and the Council for Scientific and Industrial Research.

29. A representative of the Space Advisory Company focused on the contribution of South Africa to the Netherlands-China lunar explorer, which will be the second lunar lander of China and humanity's first spacecraft to land on the far side of the Moon.

The goal is to perform astrophysical studies from translunar locations in the unexplored radio spectrum from 80 kHz to 80 MHz. The Netherlands-China lunar explorer mission is considered a pathfinder for a future low-frequency space-based or Moon-based radio interferometer.

30. A representative of JAXA introduced the two lunar CubeSats developed in his organization. Omotenashi and Equuleus had been selected as secondary payloads to the EM-1 mission of the National Aeronautics and Space Administration (NASA) of the United States. Omotenashi and Equuleus paved the way for future deep-space CubeSats and cargo vehicles to the cislunar region by demonstrating novel trajectory control techniques with limited fuel requirements.

31. A representative of the National Institute for Space Research of Brazil presented the results obtained with NanosatC-Br1, which had been launched in June 2014 and was still operational. He also spoke about the development of NanosatC-Br2, to be launched next year, and the strategy of the Institute to develop its nanosatellite programme, including payload assembly, integration and testing, on-board software development, operations and data distribution.

32. A representative of the University of Cape Town, South Africa, explained the importance of space-borne synthetic aperture radar using small satellites. Synthetic aperture radar was a mature technology with a diverse range of potential applications. It had advantages over the use of other electromagnetic wave spectrum frequencies, one of which was that it gave access to the whole surface of the Earth regardless of cloud cover.

33. A representative of Theia Space gave a presentation on his company's hands-on training satellite kit named ESAT, which showed users how various subsystems and architectures worked and how the process of integration and validation functioned.

3. Applications of small-satellite missions

34. A representative of the University of Erlangen-Nuremberg, Germany, gave an overview of how satellite-powered data analytics could be used to empower farmers. While satellite data had been used to monitor agriculture for the last three decades, the complex relationships between parameters governing crop growth and soil health had posed challenges limiting research in this field. The speaker proposed going beyond the traditional geographic information system techniques and using machine learning and parallel computing techniques to resolve those complex relationships and gain insights into crop phenology. He argued that there was a strong case for creating a disruptive technological solution for finance and governance.

35. A representative of the Mauritius Research Council introduced the MIRT-SAT1 proposal. He explained that Mauritius would be able to use CubeSats as a solution to current socioeconomic issues. MIRT-SAT1 was seen as a short- to medium-term solution, as it would be the first Mauritian infrared and telecommunication satellite to address various challenges. Additionally, the speaker mentioned that the KiboCube programme contributed to the development of the MIRT-SAT1 mission proposal.

36. A representative of Clyde Space highlighted the international partnership programme between Africa and the United Kingdom to enhance the detection of fires using nanosatellite technology. The project included a master's degree programme addressing some of the Sustainable Development Goals and illustrating the application of satellite applications. Earth observation, navigation and communications, data science, entrepreneurship and space systems were optional. The main aim was to encourage students to create new services and develop companies. The programme would be available as of September 2019. A joint PhD programme is also available.

37. A representative of HEAD Aerospace Group presented the HEAD-1 Satellite, which provided in-orbit operational data for maritime surveillance. She indicated that the company was planning to create a constellation of 30 small satellites equipped

with Automatic Identification System receivers and hyperspectral sensors. The applications would include real-time maritime surveillance services.

38. The technical session concluded with a presentation entitled "Enabling the blue economy through spatial information systems", given by a representative of the Council for Scientific and Industrial Research of South Africa. The speaker mentioned the Operation Phakisa project, which was aimed at improving the use of oceans for socioeconomic development.

4. Small-satellite projects for engineering education

39. A representative of the Department of Science and Technology of South Africa presented the objectives of the Pan-African University, its thematic principles and partners. The University is a continental network of academic, research and innovation institutions. It is composed of five hubs located in different regions of Africa. Its purpose is to develop African institutions of excellence in science and technology, enhance African postgraduate education and promote integration and cooperation in Africa through the mobility of talented and qualified applicants.

40. A representative of Nanyang Technological University of Singapore gave a general overview of the small-satellite missions developed at the University's Satellite Research Centre, its past missions, future projects and international collaboration programmes. The Centre had developed seven satellites. The most noted was the first satellite built in Singapore, XSAT, which was developed and launched in 2011. The Centre had established strategic collaboration programmes with local and international organizations that provided training opportunities for students at the undergraduate, graduate, middle and high school levels.

41. A representative of the Cape Peninsula University of Technology of Cape Town, South Africa, gave a general description of the University's satellite programme and its national and regional perspectives. The programme had led to the launch of Africa's first CubeSat, in 2013, and to the current development of Africa's second nanosatellite, to be launched in 2018. It had also resulted in the establishment of local, regional and global cooperation programmes and a proposal to design and implement a constellation of African nanosatellites.

42. A representative of the University of Auckland presented the CubeSat programme of New Zealand, the results obtained through it and its future perspectives. The programme was targeted at undergraduate students of all faculties of the University, with multidisciplinary teams potentially creating synergies. The Auckland programme for space systems was to have a CubeSat ready for launch at the end of 2018. It is to become the first satellite built in New Zealand to go into space. The programme is intended to create opportunities for students, encourage leadership and become an incubator for start-ups.

43. A representative of All Nations University of Ghana gave a comprehensive description of the main projects developed at its Space Science Technology Laboratory, its CubeSat programme and its future perspectives. The Laboratory had developed various educational programmes. The most attention was given to GhanaSat-1, a 1U CubeSat that was launched successfully from the International Space Station (ISS) in July 2017. GhanaSat-1 was the first satellite Ghana had launched into space. The country's goal for the future was to develop a GhanaSat-2 satellite to monitor illegal mining activities and the water pollution that affects Ghana.

44. A representative of Nihon University, Japan, gave an overview of its HEPTA-Sat hands-on picosatellite training kit, its main parts and stressed the importance of training on new space systems engineering. The HEPTA-Sat kit introduced students to the basic concepts of assembly, integration and testing. The hands-on training format enabled students to experiment, solve problems, design missions and receive feedback from specialists.

45. A representative of the University of Carthage of Tunisia presented the Sup'Com space programme, its strategies and its challenges. Sup'Com had

established regional and international forms of cooperation with space technology institutions and universities.

46. A representative of the Space and Upper Atmosphere Research Commission of Pakistan presented his country's national student satellite programme for space engineering education, its objectives, its current development status and the lessons learned so far. The aim of the programme was to establish collaboration between the Space and Upper Atmosphere Research Commission and academia. The programme started in 2012 with hands-on training for students. Among its achievements was the development of a functional microsatellite, PNSS-1, different modules of which were managed by different universities. Integration and testing was the next step.

5. Regulatory and legal issues and long-term sustainability of outer space activities

47. The Chief of the Committee, Policy and Legal Affairs Section, of the Office for Outer Space Affairs presented the international legal regime and governance aspects of outer space activities. He gave an overview of the countries that had ratified the five United Nations space treaties, focusing on African countries and their participation in international space governance. The speaker also highlighted new items on the agenda of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space.

48. A representative of the Office for Outer Space Affairs introduced the questionnaire on the application of international law to small-satellite activities, which had been adopted by the Legal Subcommittee in 2017 (see A/AC.105/1122, appendix II). It covered six main areas, entitled "Overview of small-satellite activities", "Licensing and authorization", "Responsibility and liability", "Launching State and liability", "Registration" and "Space debris mitigation in the context of small-satellite activities". In addition, the speaker discussed frequently observed legal and regulatory issues related to small-satellite activities.

49. A representative of the African Regional Centre for Space Science and Technology Education — in English Language, affiliated to the United Nations, discussed legal issues and responsibilities related to space technology development programmes and the need for African countries to create more national space policies and laws on space activities. He provided participants in the Symposium with a detailed overview of some pressing legal and regulatory matters associated with space activities, such as radio frequency management, national legislation and authorization.

50. The Chief Director of Space Affairs at the Department of Trade and Industry of South Africa discussed her country's legal and regulatory framework on small-satellite activities and its proposed amendments, starting with the Space Affairs Act of 1993 and including current draft legislation.

51. The Chair of the Working Group on the Long-term Sustainability of Outer Space Activities summarized the status quo of the discussions held at the Committee on the Peaceful Uses of Outer Space regarding long-term sustainability. Following the acceptance of an initial set of long-term sustainability guidelines in 2016, the progress achieved in 2017 was limited mainly to the preparation of the preambular text. Several guidelines still remained under consideration as of December 2017, including one proposed guideline focusing on small-satellite activities.

52. Small-satellite radio frequency spectrum issues was the topic of a presentation made by a representative of the Department of Telecommunications and Postal Services of South Africa. He primarily addressed the existing international regulatory framework governing frequency spectrum management and gave a general overview of existing regulations within the International Telecommunication Union (ITU) regime applicable to small-satellite missions. The speaker emphasized that actors had to act through their national authorities, as ITU only accepted applications from appointed State representatives.

53. A representative of ITU conducted a workshop on frequency registration for small-satellite missions. He explained the procedure for frequency registration through ITU SpaceCap and stressed the importance of notifying and recording the use of frequency bands by small-satellite systems in accordance with the ITU Radio Regulations.

6. Other aspects of small-satellite activities

54. A representative of the National Institute for Space Research of Brazil discussed the growing concern at the accumulation of objects in orbit. He described a new concept of de-orbiting techniques that use solar radiation pressure and atmospheric drag to force the decay of a body in orbit. The new technology used a variable area, such as an inflatable balloon, and a variable coefficient of reflectivity, and could accelerate the decay time for different types of orbits.

55. A representative of the Ghana Space Science and Technology Institute addressed the CubeSat development programme of his country, which was devoted to monitoring illegal gold mining activities using hyperspectral imagery. The programme included the design of a ground control segment for CubeSats by converting an existing antenna. In addition, the programme was expected to aid in resolving other countries' environmental and risk management issues, and in developing technical capacities in space technology.

56. A representative of the Space Advisory Company shared details of the satellite tracking ground station for the nSight-1 CubeSat mission. He addressed hardware and software design from the project perspective. Using readily available off-the-shelf components, the mission could benefit other institutions interested in establishing their own satellite-tracking capabilities.

57. A representative of the DFH Satellite Company discussed integration technology on microsatellites and nanosatellites for high-performance remote sensing. He addressed the need for higher space and time resolution at a lower cost, and illustrated how optical design could be innovated through miniaturization and integration. The presenter concluded that a revolution in big data from satellites, making them accessible and available at a low cost, could benefit countries with emerging space capabilities.

58. A representative of the Federal Institute of Education, Science and Technology of Brazil presented a system of data collection based on automated weather stations located all across Brazil that were linked to ground stations by satellite. The system currently covered 10 per cent of the country and was scheduled to scale up to become a global community based on data-sharing. The success of the project relied on the support of various institutions and had resulted in a successful spin-off company. A Brazilian satellite data transmitter had been developed to work with satellite constellations and the data could be accessed through a platform developed specifically for that purpose. The speaker took the opportunity to introduce the United Nations/Brazil Symposium on Basic Space Technology, to be held in Natal, Brazil, in 2018.

7. International experiences and opportunities

59. A representative of JAXA reported on the KiboCube programme conducted in cooperation with the Office for Outer Space Affairs, with a second CubeSat recently selected for deployment. JAXA had deployed over 200 public and private sector satellites using the Kibo module of ISS. The satellites are deployed in a down-backward fashion to avoid collision with ISS. The speaker mentioned that capacity-building and providing support to educational institutions had been the main goals of the KiboCube programme. As part of its cooperation with the Office, JAXA was providing opportunities to entities in developing countries to deploy their satellites from ISS. In addition, he invited applications for the third round of the KiboCube programme by the deadline of 31 March 2018.

60. A representative of UNISEC-Global explained that the organization was structured as a non-governmental organization with 15 country chapters worldwide and had been granted permanent observer status at the Committee on the Peaceful Uses of Outer Space in 2017. The speaker discussed the UNISEC-Global CanSat Leader training programme, which had benefited 73 participants from 34 countries since its inception in October 2010. The goal of UNISEC-Global was to promote the development of practical space projects in every country in the world by 2030 as one way to achieve the Sustainable Development Goals.

61. A representative of SCS Aerospace Group provided an overview of the SUNSAT programme in South Africa. SUNSAT was launched in 1999 and led to exchanges with NASA on the programme's battery supply, provided opportunities for visiting students from Europe and formed the basis for the development of the imager used in the Kitsat-3 satellite of the Republic of Korea. SUNSAT was followed by SumbandilaSat launched in collaboration with the Russian Federation. The speaker explained that the African resource management constellation promoted capacity-building activities and international collaboration among African countries and expressed his view on the willingness that existed to follow up with nSight-2 and nSight-3 to continue the current international collaboration and capacity-building activities.

62. A representative of Kyutech presented the BIRDS satellite project, the aim of which was to train students from developing countries on satellite design and manufacturing to enable their countries to set up a sustainable space programme. The BIRDS satellites, which fostered a human network of trained students from developing non-spacefaring countries, won the 2017 GEDC Airbus Diversity Award for this mission.

8. Poster session

63. Poster presentations were made by 20 participants from Brazil, China, Costa Rica, Egypt, Ethiopia, Ghana, Japan, Kenya, Malawi, Namibia, the Netherlands, Nigeria, Peru, Slovakia, South Africa, the Sudan, Uganda and the United Arab Emirates. The posters covered topics of scientific research, political analysis, economical growth and applications related to small-satellite activities.

C. Panel discussions

64. A panel discussion on young African space engineers in the global space arena was held, focusing on the available opportunities and main challenges.

65. In their discussions, the moderator and panellists from Egypt, Ghana, Kenya, Nigeria and South Africa discussed the opportunities and challenges for young African space engineers, covering the areas of industry and education and the topics of the cost of satellite missions and African collaborative satellite projects.

III. Observations and recommendations

66. With regard to capacity-building and international cooperation in space technology development:

(a) The participants in the Symposium noted that the African continent has a high potential for growth in the field of small satellites and can significantly benefit from an increase in the local development of satellites and use of satellite applications for social and economic development;

(b) The participants noted that space science and technology is an important tool for ensuring the sustainable use of natural resources, fostering entrepreneurship and the creation of high-technology industrial sectors. Furthermore, it makes a considerable contribution to the creation of enabling environments in which a wide

range of pressing challenges can be addressed, including the need to create jobs, reduce poverty, manage resources in a sustainable manner and develop rural areas. A formal space sector will assist Africa to realize the vision of a peaceful, united and prosperous continent;

(c) Recognizing these needs, the participants recommended that the Office for Outer Space Affairs create platforms for partnerships and capacity-building specifically dedicated to Africa, following hands-on training models such as HEPTA-Sat, KiboCube and UNISEC-Global in Africa;

(d) The participants welcomed the information that the United Nations/Japan Long-term Fellowship Programme on Nanosatellite Technologies, conducted in collaboration with the Kyushu Institute of Technology, was extended for the period 2018–2020. This was seen as an important opportunity for African academic institutions to further develop their capabilities in basic space technology and its applications;

(e) The participants acknowledged that African research councils and academia are collaborating on, among other things, the reception and dissemination of fire monitoring data and maritime domain applications;

(f) The participants recommended increasing efforts to raise awareness of the potential of small-satellite programmes for capacity-building, education, the provision of Earth observations data and telecommunication services, and technological development. The participants also recommended further consideration by African universities of a coordination mechanism for the development and operation of a constellation of CubeSats;

(g) In this regard, the participants acknowledged the necessity for increased opportunities for women in the education fields of science, technology, engineering and mathematics, in particular in space science and technology;

(h) The importance of stronger cooperation between Governments, intergovernmental and non-governmental organizations, the private sector, academia and research institutions was noted. The development of a Pan-African University network for space science and technology was encouraged. It was also recommended that a young African space dialogue be established, to be recognized by decision-making bodies such as the Pan-African Parliament and the African Union Commission;

(i) To further enhance long-term space capabilities at the national and regional levels, the educational programmes of the African regional centres for space science and technology education, affiliated to the United Nations, should be strengthened and fully utilized. The African regional centres were also encouraged to take a proactive role in building an alliance of all regional centres;

(j) The participants acknowledged the efforts of the Office for Outer Space Affairs to promote better access to space and to bridge the space divide, by enhancing access to space-based data and information and future opportunities for ground, launch and in-orbit experiments and research, as well as through the design, manufacturing and operation of small satellites;

(k) It was noted, in this regard, the importance of facilitating access to orbit for developing countries and emerging space nations, through, for example, the KiboCube programme in cooperation with JAXA. The participants encouraged the Office and potential partners to extend these opportunities to larger CubeSats, or to more than one CubeSat per year;

(l) The participants considered that in an effort to strengthen the African contribution to global governance of outer space activities, more African countries should become active members of the Committee on the Peaceful Uses of Outer Space. The Group of African States should also increase its active participation in the work of the Committee. In this regard, the participants noted the progress made in the

preparations for UNISPACE+50 under its thematic priority areas, and the opportunity to support the objectives of the African Space Policy and Strategy;

(m) In this context, the participants noted with satisfaction that the General Assembly, in its resolution 72/77 on international cooperation in the peaceful uses of outer space, welcomed the adoption of the African Space Policy by the Assembly of the African Union at its twenty-sixth ordinary session, held in Addis Ababa on 30 and 31 January 2016, and noted that this achievement marked the first step towards the realization of an African outer space programme within the framework of Agenda 2063 of the African Union;

(n) It was suggested that the African Union should consider seeking permanent observer status with the Committee on the Peaceful Uses of Outer Space to foster the African common interest in international cooperation in the peaceful uses of outer space;

(o) The participants welcomed the Legal Subcommittee questionnaire on the application of international law to small-satellite activities, covering licensing and authorization, responsibility and liability, launching State and liability, registration and space debris mitigation, and recognized its importance in raising awareness among States and the potential for sharing good practices related to small-satellite activities. States members and permanent observers of the Committee were encouraged to respond to the questionnaire;

(p) Participants encouraged African countries to develop their own space policies and strategies. This policy framework will guide and inform the ratification of United Nations treaties on outer space, and in particular, promote the universality of the Outer Space Treaty;

(q) The participants noted with appreciation the explanation on the regulatory procedure for submitting frequency registration through the ITU SpaceCap tool and recognized the importance of notifying and recording the use of frequency bands by small-satellite systems, in accordance with ITU Radio Regulations. The participants noted that the "Guidance on space object registration and frequency management for small and very small satellites", published by the Office for Outer Space Affairs and ITU, served as useful guidelines for Governments and small-satellite operators;

(r) The participants noted the importance of facilitating access to orbit for developing countries and emerging space nations. Small satellites with short-duration missions were becoming the means for such countries to become involved in space activities. A simplified regulatory regime for the coordination, notification and recording procedures for frequency assignments pertaining to small-satellite networks with short-duration missions was required, taking into account the short development cycle, the short lifetimes and the typical missions of such satellites;

(s) The participants suggested having in future symposiums a dedicated session focusing on space debris mitigation and end-of-life disposal, in accordance with the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space;

(t) The participants noted that the guidelines for the long-term sustainability of outer space activities being developed by the Committee on the Peaceful Uses of Outer Space would provide helpful guidance for governmental and non-governmental entities involved in the development and operation of small satellites. The participants further noted that the implementation of these voluntary guidelines would strengthen governance and enhance the safety, security and sustainability of outer space activities;

(u) The participants in the pilot HEPTA-Sat workshop, which was held back-to-back with the Symposium, expressed their appreciation for the hands-on activities conducted in connection with the present symposium. A hands-on workshop for a limited number of participants should in the future become an integral part of the

symposiums, which could cover educational satellite kits, FlatSats, software platforms and data analysis, among other things;

(v) The participants recommended that the Office of Outer Space Affairs should be actively involved in and keep abreast of developments in the small-satellite community by participating in, and when possible sponsoring, cooperation projects and activities and by attending relevant events such as the Annual Small Satellite Conference and the Annual CubeSat Developers Workshop;

(w) The participants expressed their appreciation to the organizers of the Symposium for the multidisciplinary and cross-sectoral nature of the symposium programme, which addressed the discipline of small satellites in a holistic manner;

(x) The participants recognized the significance of the Basic Space Technology Initiative of the Office for Outer Space Affairs and recommended that the series of symposiums on basic space technology be continued, covering the regions of the economic and social commissions of the United Nations. In that regard, the participants welcomed and endorsed the proposal of Brazil to host the next symposium in 2018, with a focus on Latin America and the Caribbean.

IV. Conclusions

67. The next symposium on basic space technology will focus on capacity-building in space technology development for Latin America and the Caribbean. Representatives of institutions of the following countries have expressed an interest in hosting a future regional workshop on basic space technology development in the period 2019–2020: Lebanon, Pakistan, Russian Federation and United States.